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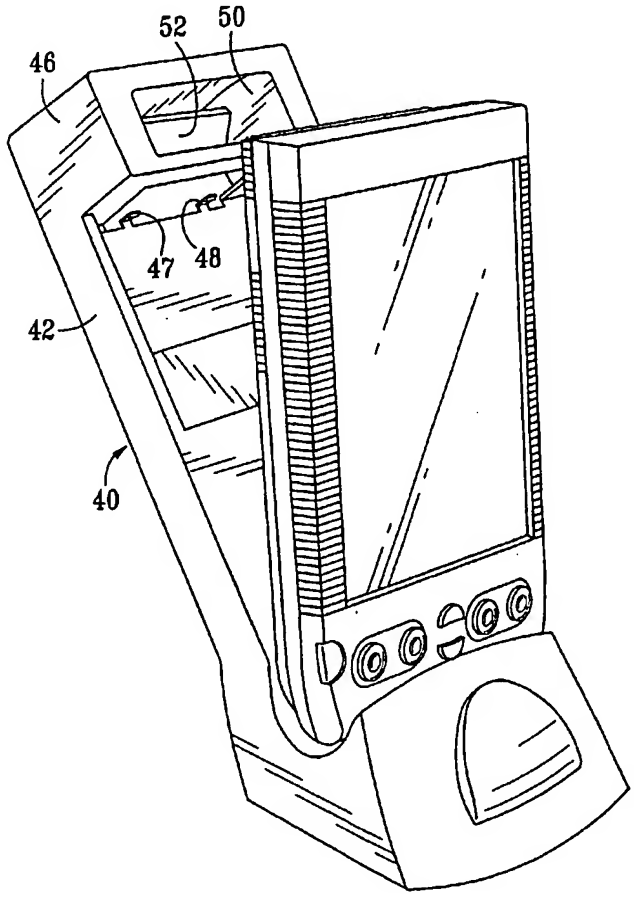
(54) Title: PORTABLE SCANNER AND CRADLE SYSTEM FOR HANDHELD COMPUTER



(57) Abstract: A data reading system including a handheld unit such as a personal digital assistant "PDA" (30) equipped with a data reader such as a bar code scanner, and a cradle system (40) into which the PDA may be inserted. The cradle system includes an electrical connector for providing a mating connection to a connector on the PDA, a mirror system (52) for reflecting a scan pattern generated from a scanner on the PDA outward through a window (50) into a scan region. The cradle may further include a communication device for providing a communication link to a host, and a battery charging device for charging batteries in the PDA.

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DESCRIPTION

Portable Scanner and Cradle System for Handheld Computer

Background of the Invention

The field of the present invention relates to scanning systems and more particularly to a system and methods for implementing and operating a handheld computer equipped with a data reader such as a bar code scanner.

Bar code scanners are ubiquitous in the retail environment. Fixed scanners installed at the checkout counter typically employ complex multi-line scan patterns to scan bar codes on items presented to the scanner or passed through the scanner scan volume. Handheld scanners, employing a trigger or some other scan start control mechanism, are connected to a host via a cable, wireless link, or some portable memory device to accommodate portable operation.

With the development of personal digital assistants (PDA's) such as the Palm™ organizer of Palm, Inc. and the Visor™ PDA of Handspring, Inc., portable computing has become increasingly available and the present inventors have recognized the possibilities for implementing such devices into the home and other locations.

Summary of the Invention

The present invention is directed to data reading system including a handheld unit such as a personal digital assistant (PDA) which is equipped with a data reader such as a bar code scanner, and a cradle system into which the PDA may be inserted. The cradle system provides for convenient holding of the unit either on a horizontal surface such as a countertop or mounted to a vertical surface such as a wall. In a preferred configuration, the cradle system includes a holder into which the PDA may be inserted; an electrical connector for providing a mating connection to the connector on the PDA; a mirror system for reflecting a scan pattern

generated from a scanner on the PDA outward into a scan region.

Brief Description of the Drawings

Fig. 1 is a front plan view of a personal digital assistant.

Fig. 2 is a rear perspective view of a system comprising a PDA with a removable plug-in scan cartridge.

Fig. 3 is a perspective view of a scan cartridge according to a preferred embodiment.

Fig. 3A is an exploded view of a preferred scan cartridge of Fig. 3.

Fig. 3B is a detailed perspective view of the upper PCB of the scan cartridge of Fig. 3A.

Fig. 3C is a detailed perspective view of the lower PCB of the scan cartridge of Fig. 3A.

Fig. 4 is a perspective view of a preferred PDA system of Figs. 1 and 3 being positioned for insertion into a cradle device according to a preferred embodiment.

Fig. 5 is a perspective view of the PDA system partially inserted into the cradle device of Fig. 4.

Fig. 6 is a perspective view of the PDA system fully inserted into the cradle device of Fig. 4.

Fig. 7 is a partial cross section view of the PDA system installed into the cradle of Fig. 6 taken along line 7-7.

Fig. 8 is a perspective view of an alternate cradle device containing a PDA system.

Fig. 9 is a partial cross section view. The cradle device and PDA system of Fig. 8.

Fig. 10 is an alternate cradle device having a split mirror for generating a multiple scan line pattern.

Fig. 11 is a perspective of an alternate cradle device and PDA system communicating via an IrDA communication link to a computer or other device.

Fig. 12 is a perspective of an alternate cradle device and PDA system communicating via an RF or other wireless communication link to a computer or via a modem connected to a phone line.

Detailed Description of the Preferred Embodiments

Preferred embodiments will now be described with reference to the drawings. To facilitate description, any reference numeral representing an element in one figure will represent the same element in any other figure.

Figs. 1-2 illustrate a PDA system 5 comprising a PDA main housing 10 and a plug-in scan cartridge 20. The cartridge 20 includes a connector 24 on one end which plugs into and mates with a connector 16 in the slot 15 of the PDA 10. The PDA 10 has a connector 14 at a bottom edge for connection to a cord or cradle as will be described below. One example of such a PDA system is the Visor™ system from Handspring, Inc. of Mountain View, California which incorporates a PDA using the Palm™ operating system into a housing having an external expansion slot capable of receiving a variety of software and hardware cartridges such as a modem, external memory, or game cartridge. Other examples of the personal organizer-type PDA include the Palm™ organizer of Palm, Inc., the Apple Newton™ organizer, the Casio Cassiopeia™ and EM-500 PDA, the Sony Clié™ PDA, and the Hewlett-Packard Jornada™ PDA. The Sony Clié™ PDA accommodates a memory stick, a plug-in capable device providing additional memory function for the PDA. Certain of these devices, such as the Handspring Visor™ PDA, may have wireless/cellular capability via a cellular cartridge. Other PDA type devices include pagers and hybrid personal communication devices such as the RIM Blackberry™, the Motorola PageWriter®, Timeport™ and Talkabout™ personal interactive communicators. Some cellular phone systems have PDA properties. The Motorola StarTac® clipon organizer is a PDA which clips on to the Motorola StarTac® cellular phone -- the PDA includes an address book via which the phone can

be dialed. For the purposes of the present disclosure, a PDA refers to any of these types of portable, handheld personal data products.

Fig. 3 illustrates the scan cartridge 20 according to a first embodiment. The cartridge 20 includes a housing 22 containing a connector 24 at one end for plug-in connection to the PDA 10 as shown in Fig. 2. The scan cartridge 20 includes a window 26 at the end opposite the connector 24. The cartridge 20 is thicker on the end proximate the window 26 to accommodate the scan engine components. The housing 22 has a flat side 27 which abuts the PDA when inserted into the PDA slot and a gradually expanding sloped side 28.

The connector 24 of the scan cartridge 20, in conjunction with the internal electronics (further details described below) may be designed to accommodate the Visor™ Springboard™ connector developed by Handspring, Inc. The electronic interface and connector preferably comprise the Springboard™ interface and connector, but other interfaces and connectors may be employed such as serial port connector, parallel port connector, USB, PCMCIA, Compact Flash, OCIA, RS 232 or other suitable interface architectures.

In a preferred configuration, the scan cartridge 20 contains a light source such a laser diode producing an optical beam; a means for scanning the optical beam (such as a spring-mounted, motor-driven dither mirror) over a scan angle to produce a scan pattern and sending the scan pattern out through the window 26; a detector for sensing return light signal; collection optics for collecting return light and directing/focusing the return light toward the detector; signal processing circuitry; and a power source.

One configuration for a scan cartridge 110 is illustrated in Figs. 3A-3C. The scan cartridge 110 comprises several sections: a lower enclosure section 120, a scan module section 130, a digital PCB section 140, and a cover section 150. The lower enclosure 120, preferably made of molded plastic, includes a thicker section 127 on the end

proximate the opening 125 containing the window 126. The enclosure 120 is thinner on the side of the end connector 144 of the digital PCB section 140. The enclosure has a sloped side 128 as in the cartridge 20 of Fig. 3.

The scan module section 130 includes a signal processing PCB 138 on which the scanner components are mounted. Scanner components include the scanning mechanism 131 comprised of a light source, namely the laser diode 132, and a scanning element drive assembly 134, preferably a motor driven dither mirror. A light beam 133 from the laser diode 132 is reflected by fold mirror 136 onto the scan mirror 135 in the drive assembly which scans the beam over an angle and then out through the window 126. Suitable collection optics are provided to focus or direct return/reflected light from the object being scanned onto a detector 137.

The detector 137, also mounted on the PCB 138, receives return light signal reflecting off the object being scanned, producing an analog signal corresponding to the intensity of the light detected. The analog signal is then processed by processor circuitry 139 on the PCB 138, which may include converting the analog signal produced by the detector 137 into a digital signal. The PCB 138 also includes laser control circuitry and scan motor control circuitry. Further details of a suitable compact scan mechanism is disclosed in U.S. Patent No. 5,870,219 incorporated by reference. Alternately, the scan engine may comprise a compact construction such as described in U.S. Patent No. 5,874,722 hereby incorporated by reference.

The interface PCB section 140 includes a PCB 142 with a connector 144 mounted on one end thereof. The PCB 142 includes the interface circuitry, shown as UART 147, providing the communication link between the scan cartridge 110 and the PDA 10. The scan cartridge 110 also includes separate power supply shown as a rechargeable battery 146 mounted on and electrically connected to the PCB 142. The PCB 142 also includes a recharging control circuit 148 for

recharging the battery 146 via connection through the connector 144, through the PDA 10 to the contacts 14, and to the connector 52 in the cradle 40 or 70 described below. The PCB 142 includes memory 143 for storing the application program for controlling operation of the scan cartridge 110. By including both a separate power supply and program memory, the requirements for memory, processing power and power consumption on the PDA itself are reduced. The signal from the lower PCB 130 is processed by the decode processor 145.

When assembled, the scan module section 130 is disposed in the lower section 127 of the enclosure 120 and the interface section 140 mounts over the scan module 130 section with the connector 144 extending to the rear edge of the enclosure 120. A metal cover 150 is secured over the top opening of the enclosure 120 enclosing the internal components. The metal cover 150 provides for shielding as between the scan cartridge 110 and the PDA 10. Further details of preferred scan module systems are disclosed in U.S. Ser. No. 09/780,104 hereby incorporated by reference.

A preferred cartridge construction usable in a Handspring Visor™ PDA may comprise the Momentum™ II scanner available from PSC Inc. of Eugene, Oregon or the CSM 150 module available Symbol Technologies, Inc. of Bohemia, New York.

Alternately, instead of a comprising a removable cartridge, the scanner may be incorporated within the PDA housing, the scanner components integrated into the PDA. In such an embodiment, the PDA may include a window in the upper section of the PDA housing in a similar location as achieved by the system 5 of Figs. 1-3. It is intended that the cradle systems described below may be used either for the systems where the scanner is incorporated into a removable cartridge such as in the Handspring Visor™ PDA or where the scanner is integrated into the PDA. Integrated systems may include, for example the SPT 1500, SPT 1700, or PPT 2700 pocket computer/scanners available from Symbol

Technologies, Inc. of Bohemia, New York. Such a cradle system may also be applied to certain consumer scanners such as the CS 1505 or CS 2000 scanners also available from Symbol Technologies, Inc.

Fig. 4 illustrates a PDA-scanner system 30 comprised of a PDA 10 having the scan cartridge 20 of Fig. 3 or scan cartridge 120 of Fig. 3A installed thereon. Figs. 4-6 illustrate a process by which the PDA system 30 may be inserted into the cradle 40.

The cradle 40 includes a main housing section 42, a base section 44 and a top section 46. The main or rear section 42 is tilted rearwardly from the base section 44 such that when the unit 40 is resting on a horizontal surface such as a countertop, the PDA 10 faces angularly upward thereby facing the user. The typical user standing next to a counter or sitting at a desk will usually have an eye level higher than the cradle 40 resting on the surface, thus the upwardly angled position tilts the PDA 10 to a desired orientation for convenient use and viewing.

The base section 44 includes a receptacle portion 45 having a concave rounded section with a connector 52. As shown in Figs. 4-5, when the PDA system 30 is inserted into the cradle 40, the rounded section of the receptacle 45 guides the unit into position mating the connector 14 on the PDA with the connector 52 on the cradle 40. The lip of the rounded section serves to hold the PDA in place when inserted.

The main section 42 of the cradle 40 has an enlarged section 43 for accommodating the thick-sized scanner cartridge 20. The top section 46 includes clips 47, 48 (see Fig. 5) which engage the top edge of the PDA system 30 when it is fully inserted into the cradle 40 (as shown in Figs. 6-7).

The top section 46 of the cradle 40 includes a mirror 52 and an exit window 50 and an inlet window 51. The windows 50, 51 provide for an enclosed interior to seal off the cradle components. The mirror 52 is disposed at an

angle of about 45° to the incoming beam 60 thereby deflecting the scan pattern at about 90°. The scan cartridge 20 produces a scan pattern and directs it out the cartridge window 26. When the PDA-scanner system 30 is positioned in the cradle 40 (as shown in Figs. 6-7) the cartridge window 26 is positioned directly below the window mirror 52. The scan pattern 60 generated by the data reader (such as a single scan line if the data reader is a laser scanner) is reflected by the mirror 52 and directed out through the cradle window 50. By reflecting the scan pattern with the mirror 52, the scan pattern is directed out into a scan field where the user may conveniently position a bar code label in front of the window 50 in order for the label to be scanned. Reflected light from the scanned object returns along the same path.

Figs. 8-9 illustrate a cradle 70 of an alternate design. The cradle 70 has an upper housing section 72 which includes an inclined front section containing the window 74. The cradle mirror 78 is positioned to reflect the beam 80 from the scan cartridge angularly downward. The scan pattern 80 may be formed by a visible laser or may alternately include an aiming beam which is visible to the user when the item to be scanned is placed in the beam path. By angularly directing the beam 80 downwardly, an object 90 to be scanned may be positioned generally horizontally in the beam path such that the user holding the item would have a line of sight 95 onto the object enabling him/her to observe and position the label as desired in the scan field.

Though the mirrors 52, 78 may disposed at a fixed angle to the incoming beam 60, alternately, the angle of the mirrors 52, 78 may be adjustable by a suitable mechanism. For example, as shown in Figs. 6-7, the mirror 52 may be mounted on a rotatable rod 53 which extends outward from the housing which allows the angle of the mirror 52 to be manually adjusted a few degrees by the user.

In the configuration where the data reader is a laser scanner, the mirror 52, 78 may be connected to a dithering

mechanism to provide a two-dimensional scan pattern (as it is likely that the scan pattern produced by the scanning device will be a one dimensional (single line) pattern). For example as shown in Fig. 9, the mirror 78 may be mounted on a dithering mechanism 79 which thereby produces a two-dimensional scan pattern out window 74 to facilitate scanning of the bar code on the item 90.

The cradle mounts disclosed, such as device 40 of Figs. 4-7 or device 70 of Figs. 8-9, may be conveniently mounted on a wall via suitable wall mounting connectors, such as screws 99 (see Fig. 9), passing through the housing 72.

In alternate configurations, where the data reader comprises a laser scanner producing a single scan line, the mirror system may comprise a plurality of mirrors arranged at differing angles thereby producing a multi-line scan pattern out the cradle window 50 or 74. For example, Fig. 10 illustrates a cradle 190 with an alternate mirror system 197 replacing single mirror 78 of the cradle 70 of Figs. 8-9 with two mirror sections 197a, 197b arranged at different angles. The mirrors 197a, 197b are arranged side by side such that a single scan line produced by the scan mechanism passes across one mirror section then the other thereby forming an X pattern of two intersecting scan lines projected into the scan volume.

Though the disclosed embodiments generally illustrate a laser bar code scanner type of data reader, any suitable data reading device such as a CCD imaging data reader, an LED reader, CMOS imaging reader, or the like may be employed. Typically these readers have a field of view out through a scanner window. Certain of these readers project a scan pattern out through the window. A laser bar code scanner, for example, may produce a scan pattern of one or more scan lines for reading bar codes presented to the scanner or passed through the scan volume. Data reading devices may read 1-D or 2-D optical codes, product identification, fingerprint ID, or other items such as might

be required to be scanned in a retail environment or elsewhere.

Communication of the data collected by the cradle scanner system may be accomplished in several ways. A standard computer connection may be employed via a serial interface or a USB interface. This standard interface connection requires direct connection via cables to a computer which may or may not be conveniently located in or near the usual cradle location such as in the kitchen. Alternately, the cradle may contain an IRDA connection/interface or RF connection/interface, such as the Bluetooth standard, which would connect the cradle to a computer or an internet service device located elsewhere on the premises without the need for cables. Finally, the cradle may contain a modem wired into a phone line using a dial-up, DSL, ISDN or other type connection. Other communication connector, such as the cable TV coax may be employed. Under control of the PDA, the modem may be used to connect directly into a supplier's server and download the collected data or upload new data to the PDA. This approach may completely eliminate the need for a separate local computer.

Figs. 11 and 12 illustrate alternate cradle configurations. The cradle system 150 of Fig. 11 includes an IRDA communication port 154 in the base 152 which may communicate via infrared optical signals with a corresponding IRDA port 162 on the computer 160 or other suitable device. Alternately, the PDA 30 itself may be provided with an IRDA port 32 to provide a communication link.

The cradle system 170 of Fig. 12 includes an RF antenna 174 in the base 172 which may communicate via RF signals with a corresponding RF antenna/port 179 on the computer 178 or other suitable device, or may comprise an entirely wireless connection, such as Bluetooth, connecting to the vendor directly or via the internet.

In yet another embodiment, the cradle system 170 of Fig. 12 is illustrated to include a modem 180 disposed in the cradle base 172. The modem 180 is connected to or includes a phone cord jack 182 (e.g. for accepting an RJ-11 connector) which may be connected by a phone cord 184 to a wall jack 186. The system may then connect via a phone line to the store computer either directly or via the internet, for example, to download a grocery order list, payment and delivery information.

Though the present invention has been set forth in the form of its preferred embodiments, it is nevertheless intended that modifications to the disclosed cradle may be made without departing from inventive concepts set forth herein.

Claims

1. A data reading system comprising:

a handheld unit such as a personal digital assistant including a display screen, a plurality of input keys, an externally-accessible connector, a window disposed along a top surface, and an optical scanning device generating a scan pattern projected out the window;

a cradle including:

a cradle housing having a bottom section including a receptacle for receiving the handheld unit and a connector disposed in the receptacle portion for connection to the connector of the handheld unit when the handheld unit is inserted into the cradle, and a top section extending over the top surface of the handheld unit and over the window when the handheld unit is disposed in the cradle,

a mirror system disposed in the top section of the cradle housing for reflecting the scan pattern generated by the optical scanning device out into a scan region.

2. A data reading system according to Claim 1 wherein the cradle further comprises

a communication means for providing a communication link between the handheld unit and a host or other system,

a battery charging means for charging batteries in the handheld unit.

3. A data reading system according to Claim 1 wherein the handheld unit comprises an externally-accessible slot having a plug connector, a small removable peripheral device in the form of a plug-in module insertable into the slot, wherein the optical scanning device is disposed in the module, the module comprised of

a module housing for containing module components,

circuitry disposed in the module housing, including a module interface circuit, a module processor and module memory,

an interface bus and a plug connector disposed on one end of the module housing for mating with the plug connector of the slot.

4. A data reading system according to Claim 3 wherein the module further comprises a rechargeable battery.

5. A data reading system according to Claim 1 wherein the optical scanning device directs a scan pattern out the window in a plane generally parallel to the display screen, the mirror system reflecting the scan pattern forwardly of the handheld unit.

6. A data reading system according to Claim 1 wherein the mirror system in the cradle reflects the scan pattern forwardly and slightly downwardly toward a scan region in front of the display screen.

7. A data reading system according to Claim 1 wherein the bottom section of the cradle comprises a base for supportedly positioning the cradle on a horizontal surface.

8. A data reading system according to Claim 7 wherein the upper section of cradle housing is tilted rearwardly from the bottom section such that the display screen of the handheld unit faces angularly upward when the cradle is resting on a horizontal surface.

9. A data reading system according to Claim 1 wherein the cradle housing is mountable to a wall.

10. A data reading system according to Claim 1 wherein the cradle an interface for connection to an external host.

11. A data reading system according to Claim 1 wherein the cradle includes a communications interface selected from

the group consisting of: USB, parallel, serial, IRDA, RF, Bluetooth.

12. A data reading system according to Claim 1 wherein the cradle includes a modem and a phone jack for providing external communication link.

13. A data reading system according to Claim 1 wherein the cradle includes a means for actuating the mirror to adjust direction of the scan pattern exiting the cradle housing.

14. A data reading system according to Claim 1 wherein the optical scanning device comprises a laser scanner producing a single scan line, and the cradle includes a dithering mechanism for dithering the scan line for generating a two-dimensional scan pattern.

15. A data reading system according to Claim 1 wherein the cradle housing includes a front window inclined through which the scan pattern from the mirror passes though at an angle of about 90°.

16. A data reading system according to Claim 1 wherein the optical scanning device comprises a laser scanner producing a single scan line, and wherein the mirror system comprises a first and second mirrors arranged at different angles for splitting the single scan line into first and second scan line portions producing an X scan pattern.

17. A data reading system comprising:

a handheld unit, such as a personal digital assistant holdable in a palm of person's hand, including a plurality of actuation keys, an externally-accessible connector, a window disposed along a top edge surface, and an optical reader positioned to read optical codes in a field of view projected out through the window;

a cradle including:

a cradle housing having a bottom section including a receptacle for receiving the handheld unit and a top section extending over the top surface of the unit and over the window,

a mirror system disposed in the top section of the cradle housing for reflecting the field of view of the data reader at about a ninety degree angle.

18. A data reading system according to Claim 17 wherein the optical reader is selected from the group consisting of: laser bar code scanner, CCD imaging reader, LED reader, CMOS imaging reader.

19. A data reading system comprising:

a handheld unit such as a personal digital assistant including an externally-accessible connector, a window disposed along a top surface, and an optical scanning device generating a scan pattern projected out the window;

a cradle including:

a cradle housing having a bottom section including a receptacle for receiving the handheld unit and a connector disposed in the receptacle portion for connection to the connector of the handheld unit when the handheld unit is inserted into the cradle, and a top section extending over the top surface of the handheld unit and over the window when the handheld unit is disposed in the cradle,

a mirror system disposed in the top section of the cradle housing for reflecting the scan pattern generated by the optical scanning device out into a scan region.

20. A data reading system according to Claim 19 wherein the mirror system reflects the scan pattern to a position generally in front of the handheld unit.

21. A data reading system according to Claim 20 wherein the cradle further comprises a communication link for communicating to an external system.

22. A data reading system according to Claim 20 wherein the communication link is selected from the group consisting of: a telephone modem, IRDA link, RF link, USB interface, parallel interface, serial interface, or Bluetooth link.

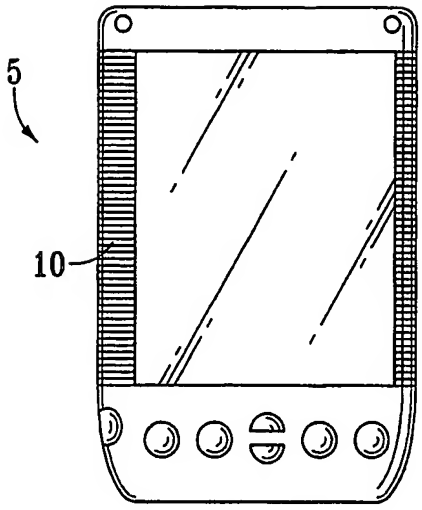

FIG. 1

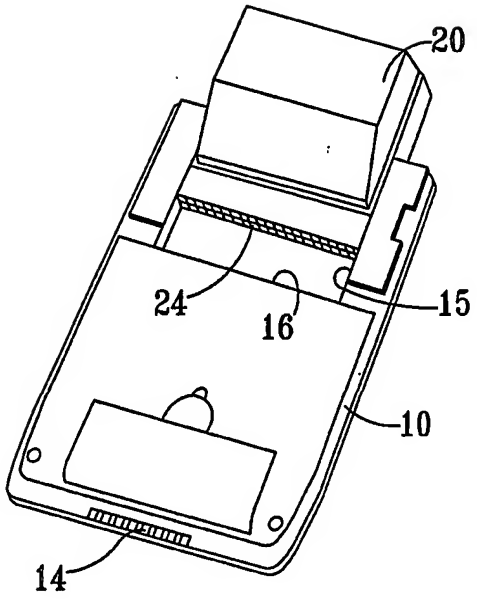

FIG. 2

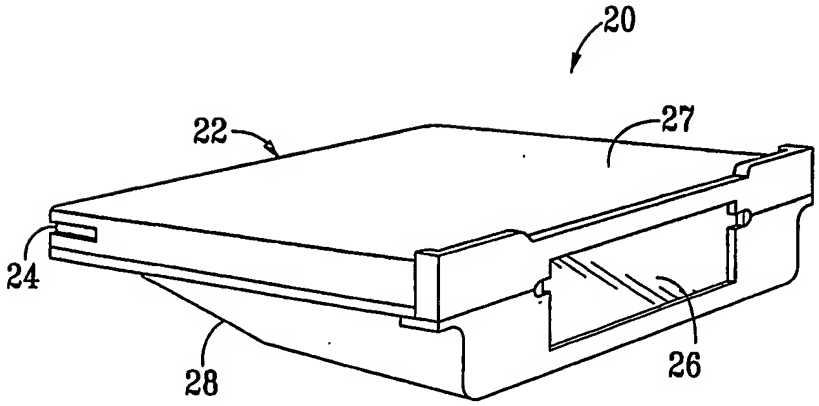

FIG. 3

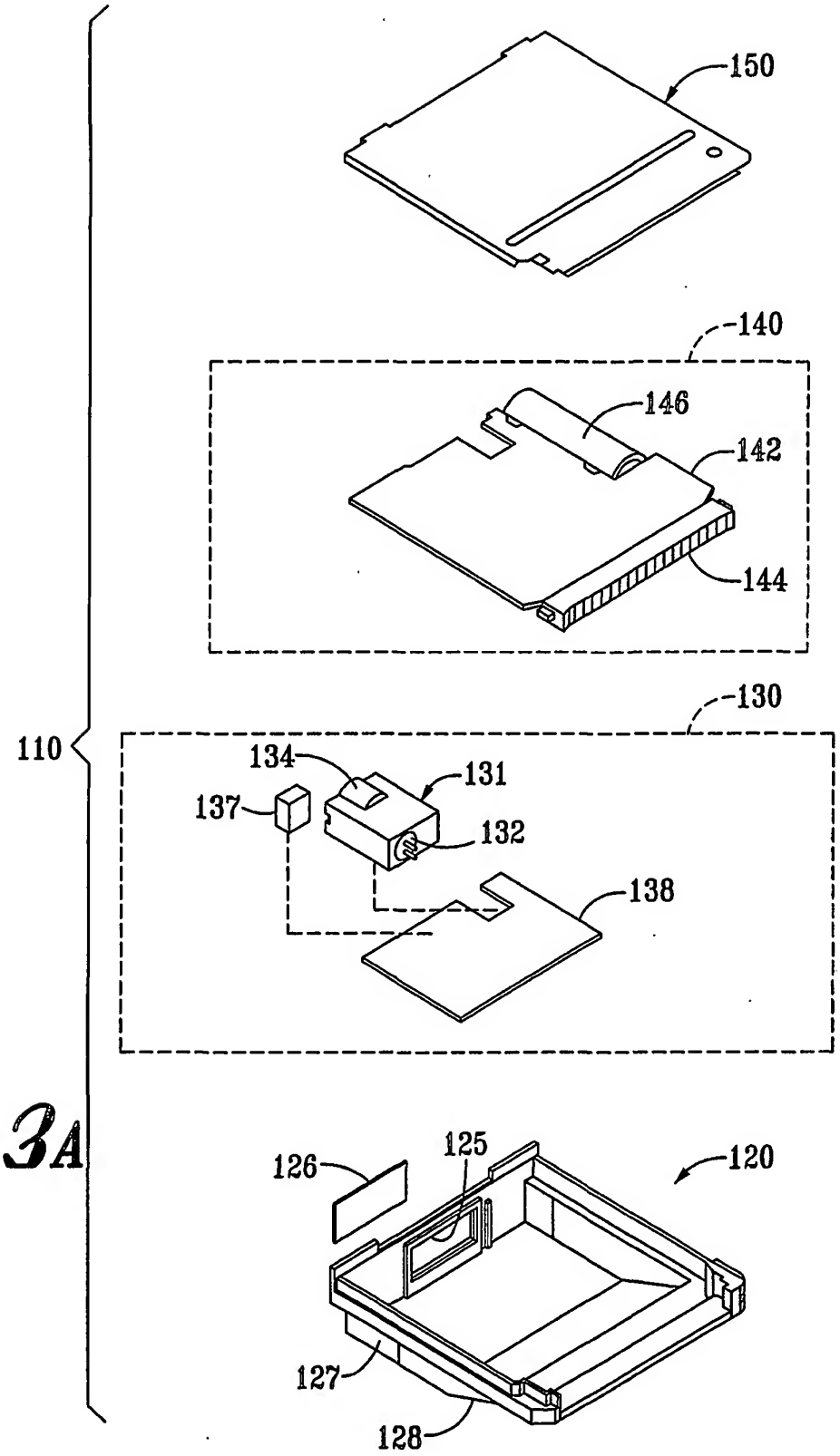
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FIG. 3A

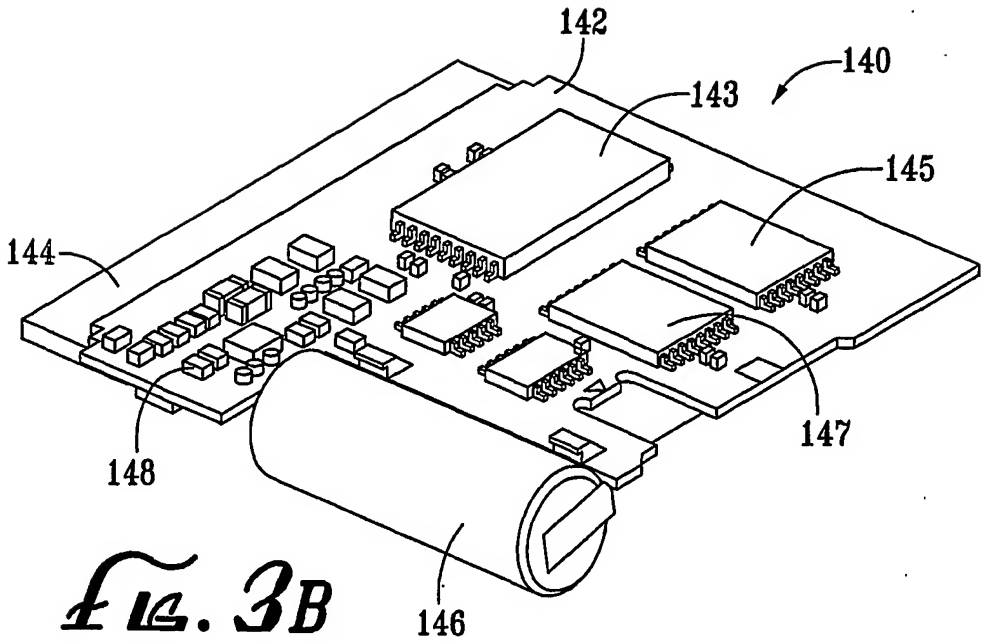
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FIG. 3B

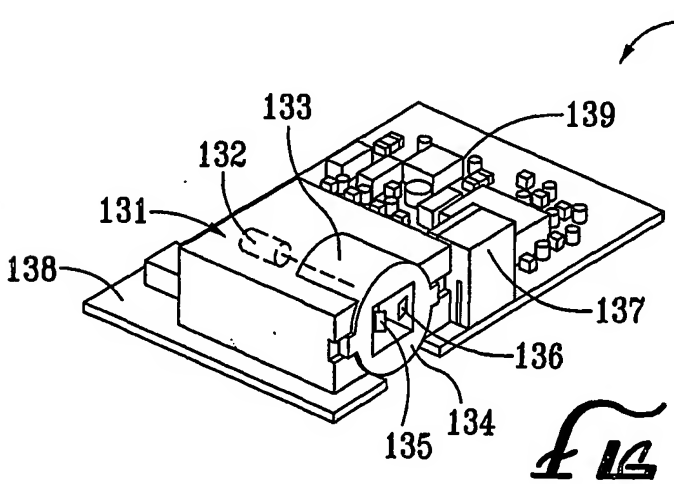
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FIG 3C

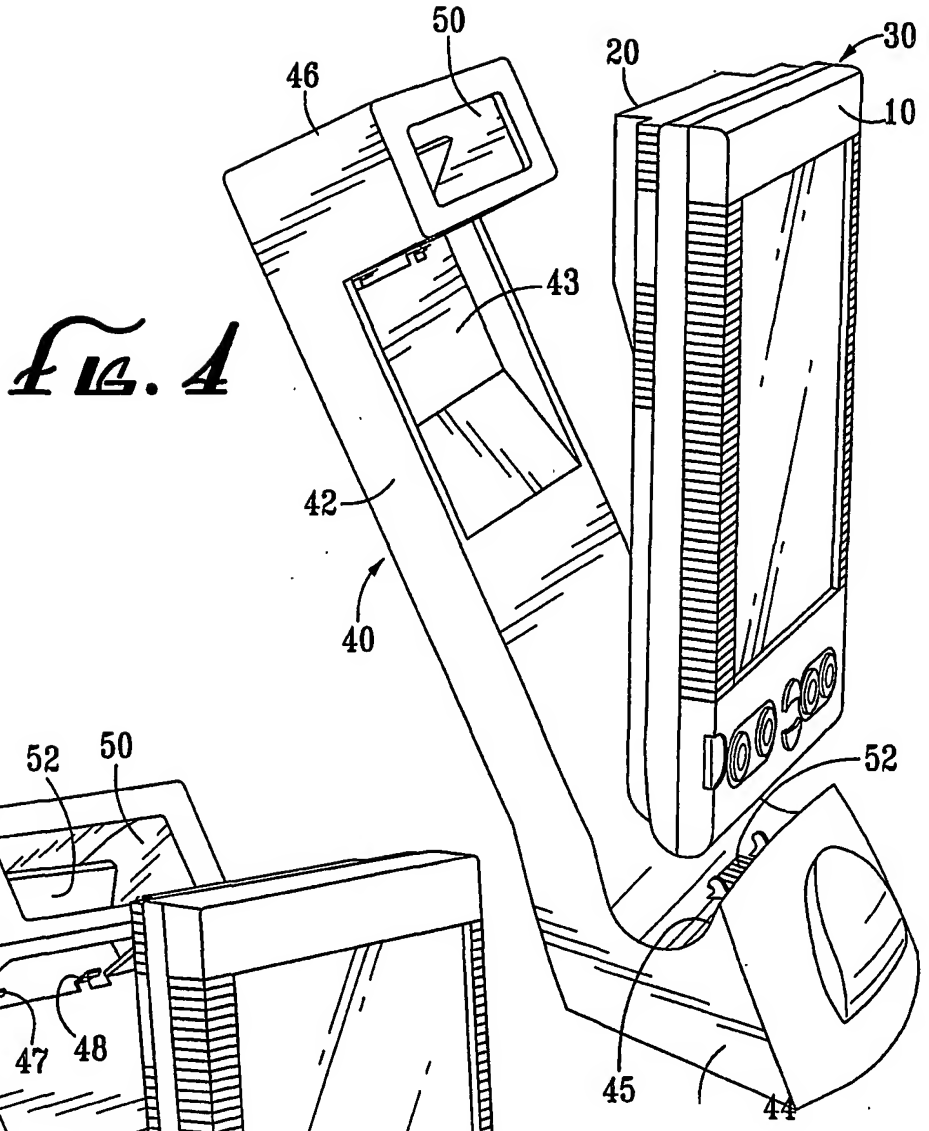

FIG. 4

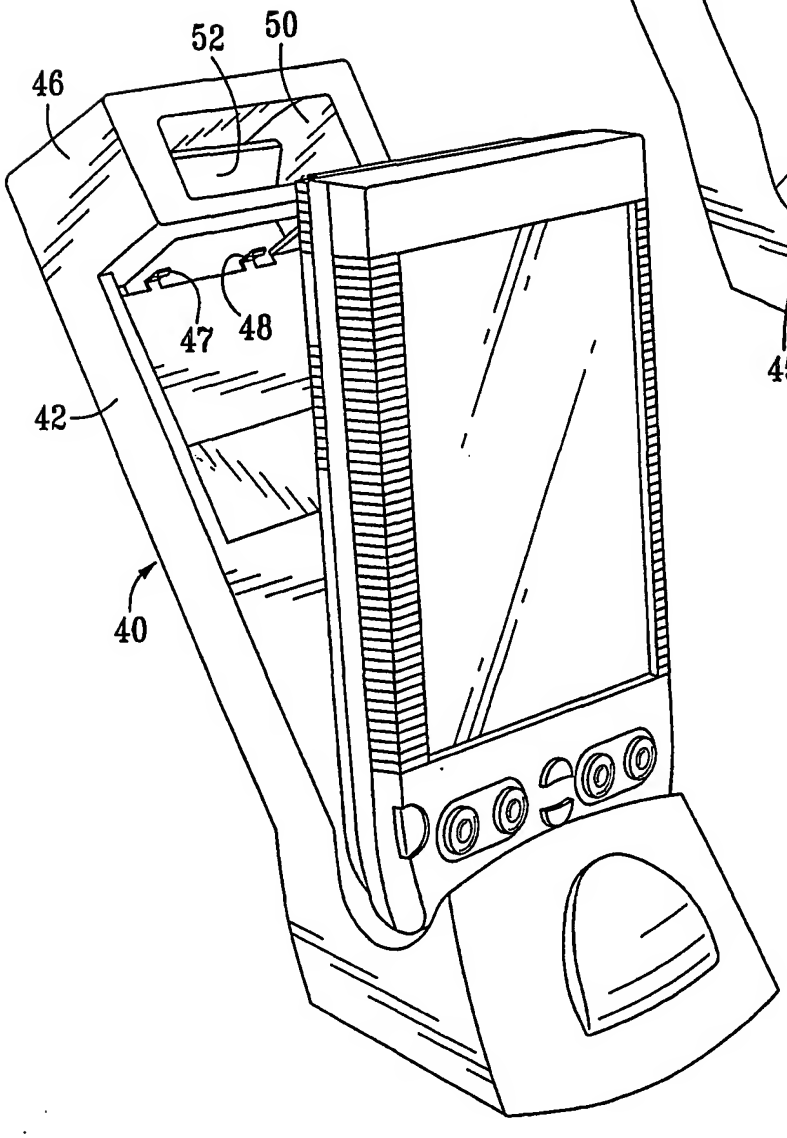

FIG. 5

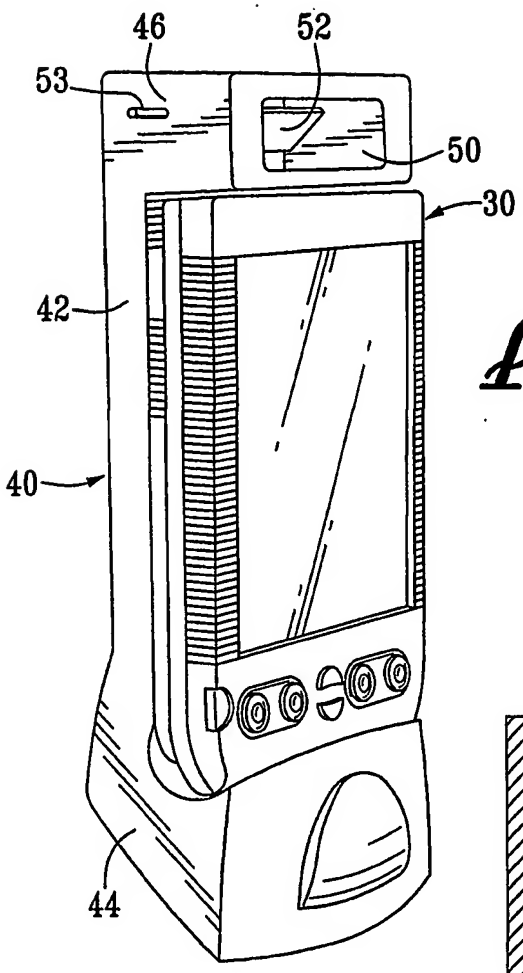

Fig. 6

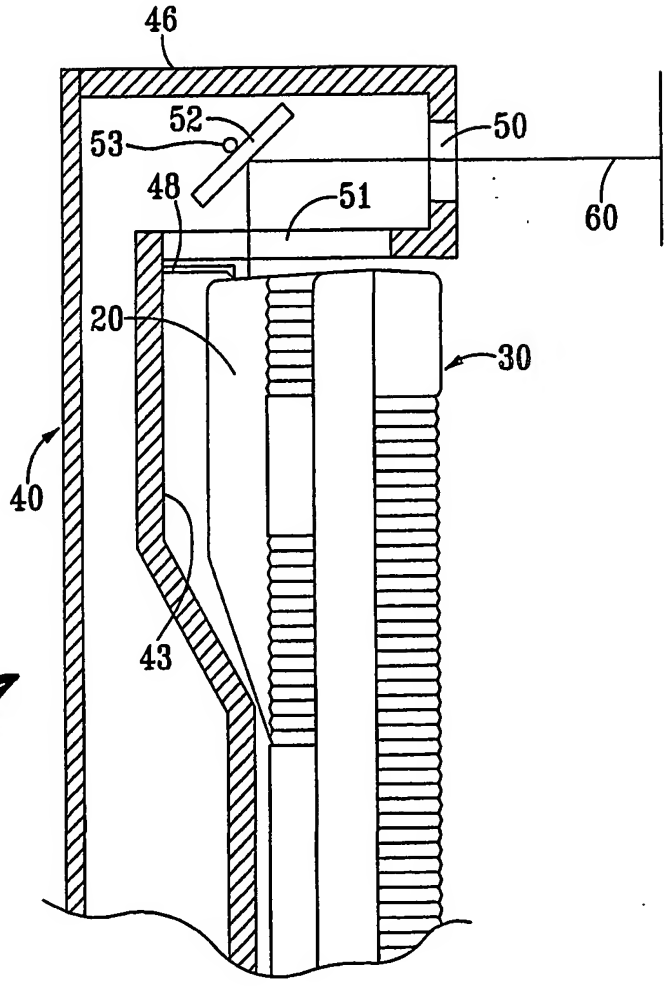

Fig. 7

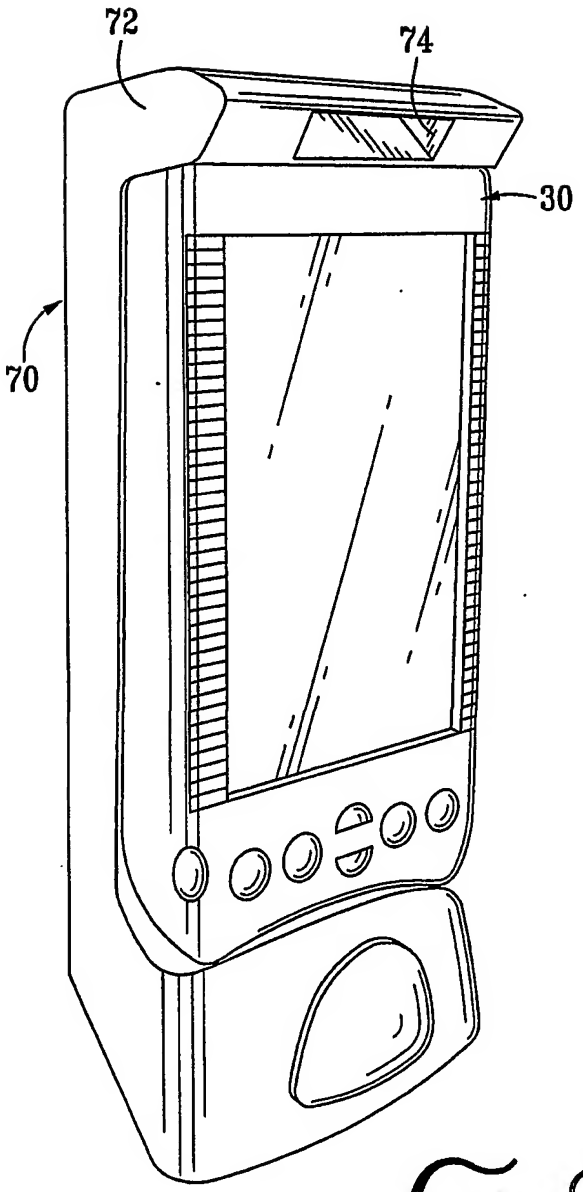

FIG. 8

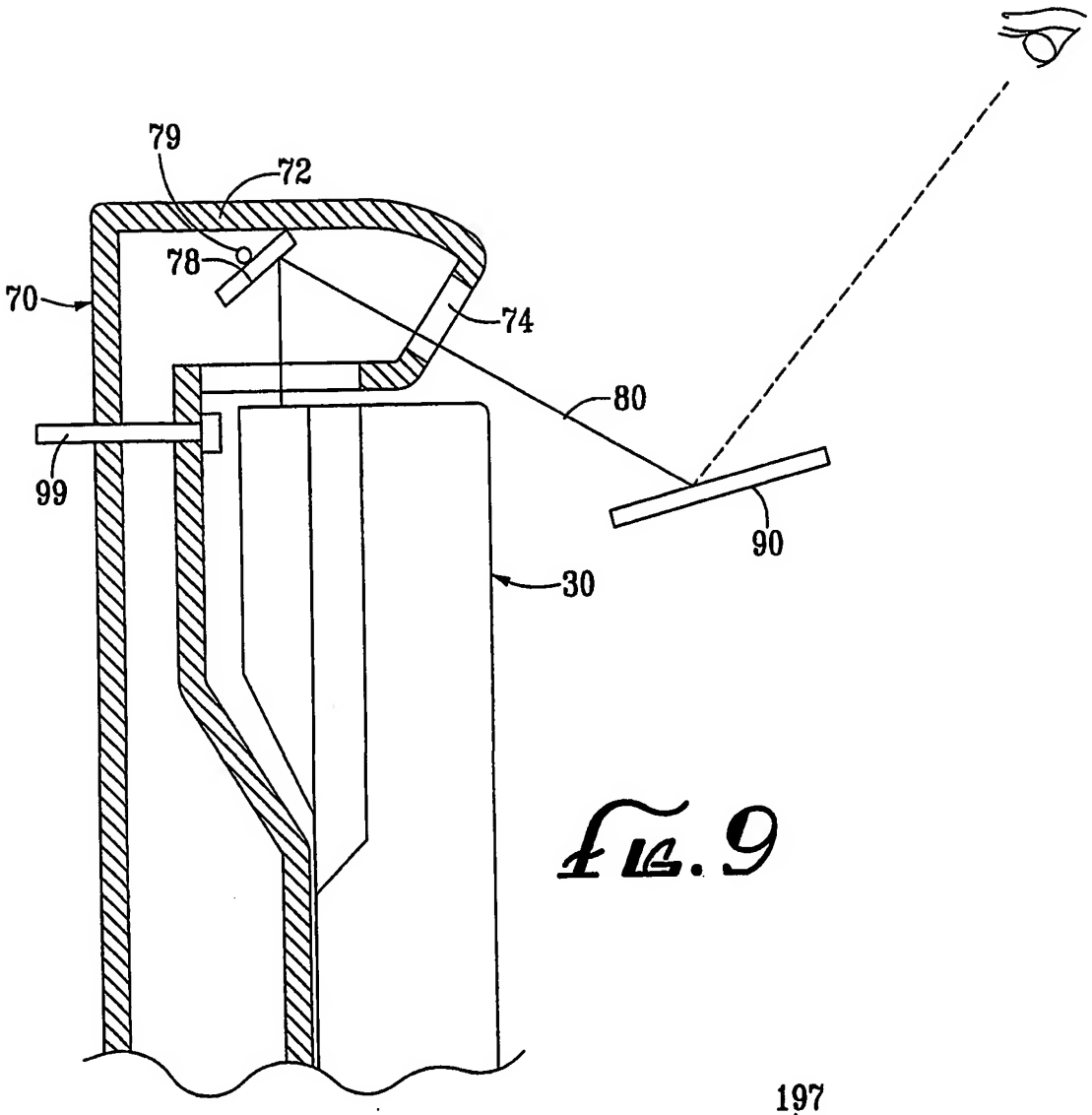

FIG. 9

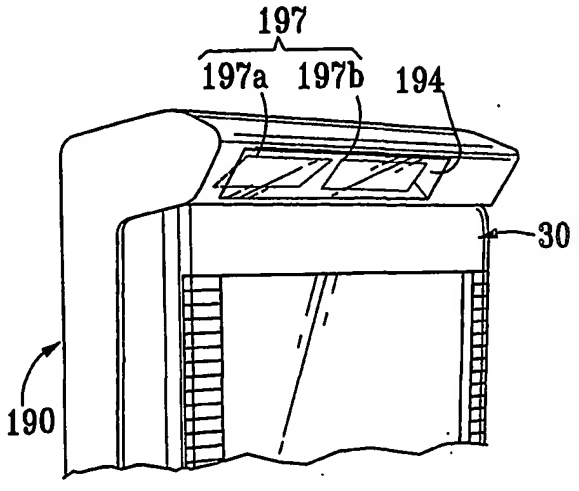

FIG. 10

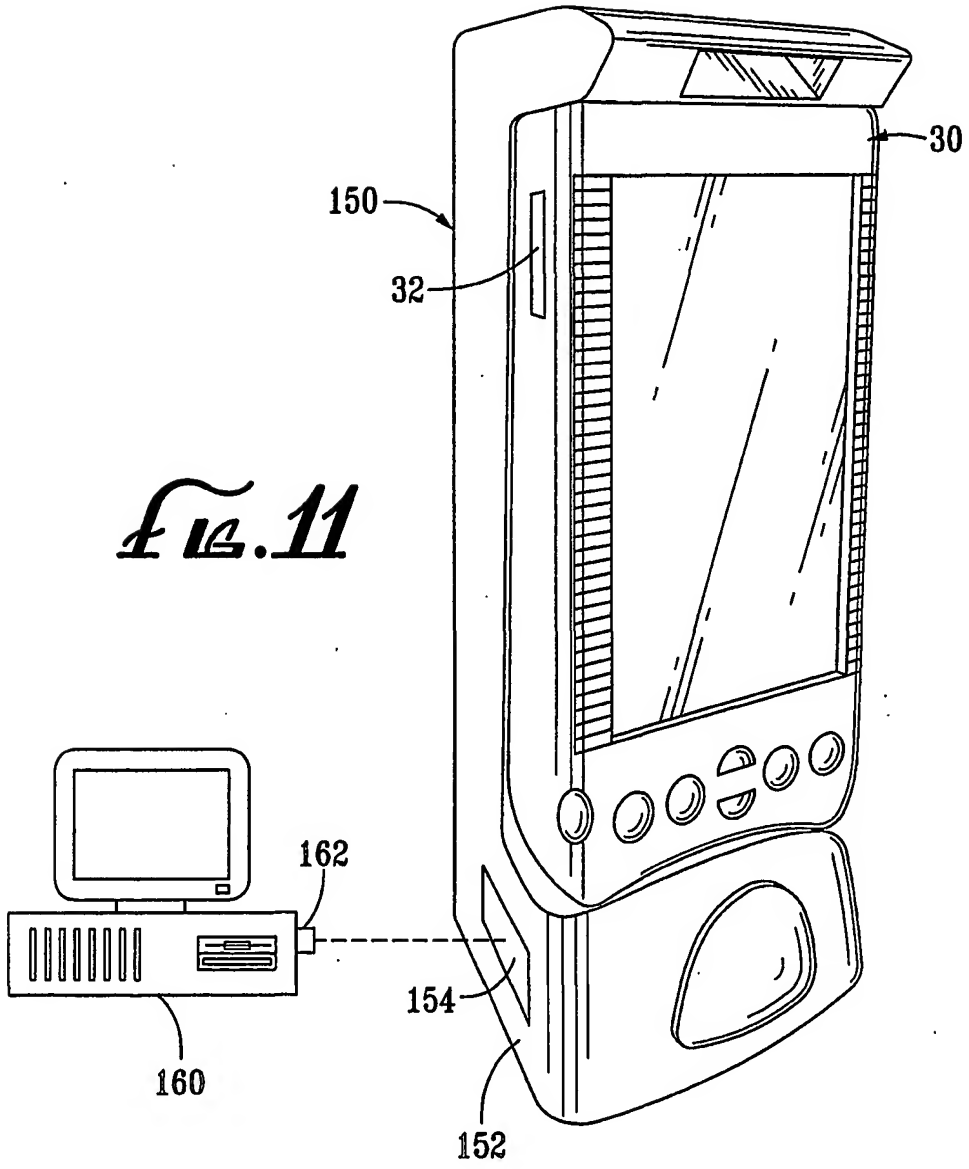

FIG. 11

Fig. 12